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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/698,179	10/30/2003	Thomas W. Kenny	COOL-01302	2504

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EXAMINER	
FORD, JOHN K	
ART UNIT	**PAPER NUMBER**
3744	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/698,179	KENNY ET AL. CT
	Examiner	Art Unit
	John K. Ford	3744

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on Nov 9, 2007

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1, 8-27, 29-33, 35-127 is/are pending in the application.

4a) Of the above claim(s) 9, 11, 15, 18, 20-27, 33, 35-37, 39, 42, 43, 45-127 is/are withdrawn from consideration.

5)☐ Claim(s) ____ is/are allowed.

6)☒ Claim(s) 1, 8, 10, 12-14, 16, 17, 19, 29-32, 38, 40, 41, 44 is/are rejected.

7)☐ Claim(s) ____ is/are objected to.

8)☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on ____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 2/5/07 + 4/16/07 + 6/8/07 + 9/10/07 + 10/22/07 + 11/30/07 + 12/7/07

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ____ .

5)☐ Notice of Informal Patent Application

6)☐ Other: ____.

Applicant's response of November 9, 2007 has been carefully considered. In it applicant sends in a duplicate (or what appears to be a duplicate) of the replacement sheet of the July 30, 2007. Is that correct? Please note that the examiners only was calling for, in the October 18, 2007 Notice of Non-responsive amendment, a listing of claims. Why applicant sent in a duplicate (or what appears to be a duplicate) drawing is confusing. The examiner is unsure which drawing is the replacement drawing. Please send in a properly labeled replacement sheet.

Even more confusing is applicant's allegation that all of claims 1, 8-19, 29-32 and 38-44 read on the elected species. This application is currently an RCE of the earlier application and the original election and restriction requirements carryover. The only thing applicant had to do was elect among some sub-species disclosed as alternatives used in Figures 3A-3B (but not all of them being illustrated) as clearly set forth in the office action of March 27, 2007. Applicant elected (now Figure 21) a species of Figures 3A-3B, wherein, instead of microchannel walls 110 as shown in Figure 3B, applicant now has, in Figure 21, replaced those microchannel walls 110, with a porous structure 110' that can be <u>one</u> of sintered metal or silicon foam. Among these two alternatives of material, applicant elected <u>sintered metal</u>.

It is submitted that going back to the final rejection mailed November 14, 2006, the claims non-elected claims were 4, 5, 9-12, 15, 18, 20-27, 38-40, 42, 43 and 45-127. The claims that were readable on the elected species at that time were 1-3, 6-8, 13, 14, 16, 17, 19, 28-37, 41 and 44. In reading over the amended claims as they appear here, it appears that claims 10, 12 and 38 are also readable on the elected species. Of those

two groups of claims, only claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29-32, 38, 40, 41 and 44 are readable on the currently elected species and all of the claims except those designated by the examiner are removed from consideration here as being directed to non-elected inventions/species/sub-species, pursuant to MPEP 821. An action on the merits follows on claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29-32, 38, 40, 41 and 44.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29-32, 38, 40, 41 and 44 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1, it is unclear whether applicant is claiming the combination of a heat exchanger and heat source or just the heat exchanger alone. Please clarify the claims and address some comments in the written record to whether you are claiming the combination of a heat exchanger and heat source or just the heat exchanger alone.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 10, 12, 13, 14, 17, 19, 32, 38 and 40 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Anderson et al (USP 5,761,037).

Anderson, assigned to IBM, shows a heat source 30 (an integrated circuit "chip") contacting a conducting portion 104 of a heat exchanger. A heat exchanging layer 103 of sintered copper (a microporous sintered metal according to applicant's own examples in his own disclosure) is shown. An inlet port connected to pipe 21 and an outlet port connected to pipe 11 are shown in Figure 4. While no particular region in Anderson's integrated circuit chip is disclosed as being hotter than another, arguably applicant's claim doesn't even claim an integrated circuit chip so the limitation is not given weight absent a claim to the overall combination. Notwithstanding that fact, it is apparent that the "hot spot region" 104 is cooled far more in the center than right at the edge because of the geometry of the device. Regarding claim 10, see the outlet in Figure 4 connected

to pipe 11. Regarding claims 12 and 13 fluid inlet and outlet grooves are shown in layer 102. Claim 14, being a method of use limitation in an apparatus claim, is not a limitation on the apparatus itself (for further explanation, see MPEP 2114, incorporated here by reference). Regarding claim 17 there is no overhang shown between the layers 101, 102, 103 and 104. Since there is no overhang and applicant's claimed range includes an overhang of "0" (i.e. zero) millimeters, this limitation is met. Regarding claim 32, every porous material by the nature of its formation is formed with irregular pores that inherently vary randomly over the flow path as a consequence of their random orientation. Regarding claims 38 and 40, see Figure 4 of Anderson wherein the body is at least thermally coupled to the integrated circuit chip.

Claims 1, 10, 12, 13, 14, 17, 19, 32, 38 and 40 are rejected under 35 U.S.C. 103(a) as obvious over the combined teachings of Anderson et al (USP 5,761,037) and either Hou (USP 5,983,997) or Messina et al (USP 5,239,200).

Hou teaches forming different flow channel structures to provide different cooling rates to different parts of the heat transfer surface. Messina teaches the same thing in regard to the explanation of Figure 5, incorporated here by reference. In view of either of these teachings it would have been obvious to have structures the passageways and flow rates in Anderson to concentrate cooling in certain areas of high heat load.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Andersen alone or in view of Hou or Messina as applied to claim 1 above, and further in view of Chu (USP 3,993,123).

To have used an inlet port in Anderson (at 106) with a 90 degree elbow in it as shown at the bottom right of Figure 1 of Chu to permit lateral routing of the fluid flow delivery pipe would have been obvious to one of ordinary skill in the art.

Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson alone or in view of Hou or Messina as applied to claim 1 above, and further in view of Herrell (USP 4,758,926).

The thickness of layer 104 is not disclosed in Anderson.

In Herrell layer 40 is 25 mils thick. Each mil is 25.4 microns. Layer 40 is therefore 635 microns thick. 635 microns is 0.635 millimeters, within applicant's claimed range. To have made the layer 104 of Anderson .635 millimeters thick as taught by Herrell would have been obvious since it is shown by Herrell to be a dimension that works.

Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anderson alone or in view of Hou or Messina as applied to claim 1 above, and further in view of Tonkovich (USP 6,680,044).

As disclosed the porosity of the porous microstructure should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being claimed are ultimately for the designer to select in any given heat transfer application. To have configured the porous intermediate layer of Anderson with a porosity that is known to provide good fluid flow as taught by Tonkovich in col. 2, lines 50-63, incorporated here by reference (teaching a porosity within applicant's claimed range as well as pore sizes in applicant's claimed range and a channel height with applicant's claimed range), would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients.

Claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29, 30, 31, 32, 38 and 40 are rejected under 35 U.S.C. 103(a) as obvious over Herrell et al. (USP 4,758,926) in view of the Jiang et al article "Thermal-Hydraulic performance of small scale micro-channel and porous-media heat exchangers"

Herrell shows a body 10 having a planar conducting portion 40. Plural heat sources 36 are shown. An intermediate conducting layer 44 is shown. The body has an inlet port 14 and an outlet port 16. Fluid from the inlet port is channeled to the conducting portion 40. The microchannels 42 in the conducting portion 40 distribute the

fluid (after exchanging heat with the heat sources 36) after it has passed "therethrough" (i.e. through the microchannels 42 in the conducting portion 40) to the intermediate conducting layer 44. The intermediate conducting layer 44 has fluid passing through it in through-passages (best seen running vertically between manifolds 48 and 50 in Figure 6 of Herrell) that fluidly connect the microchannels 42 in the conducting portion 40 to passages in the top layer 46 for eventual discharge from outlet 16.

The Jiang article discloses the art recognized equivalence of microchannel structures 42 of Herrell and porous microstructures as claimed by applicant currently. To have made the microchannel structures 42 of Herrell of microporous media as taught by the Jaing article would have been obvious to one of ordinary skill in the art. In general the microporous media is advantageous in terms of having better heat transfer than the microchannel structures 42 of Herrell as would have been obvious to have used for that reason in spite of their somewhat higher pressure drop.

Regarding claim 8, second layer 46 includes the inlet port 14, outlet port 16 and the inlet port 14 is substantially parallel to the plane of the second layer 46. Regarding claim 13, grooves (i.e. long narrow channels) are shown in Figure 5 channeling fluid from one of the manifolds 50 (each of which is connected to the intermediate conducting layer) to an adjacent manifold 50 and eventually to the outlet 16. Claim 14, is satisfied because Herrell does not disclose any boiling or vaporization of the heat exchange fluid. Alternatively claim 14, being a method of use limitation in an apparatus claim is not a

limitation on the apparatus itself (for further explanation, see MPEP 2114, incorporated here by reference). Regarding claim 16, layer 40 is 25 mils thick. Each mil is 25.4 microns. Layer 40 is therefore 635 microns thick. 635 microns is 0.635 millimeters, within applicant's claimed range. Regarding claim 17, in Figure 3, left hand side there is no overhang shown between layer 40, 44 and 46. Since there is no overhang and applicant's claimed range includes an overhang of "0" (i.e. zero) millimeters, this limitation is met by Herrell. Regarding claim 19, while the preferred material of manufacture in Herrell is silicon, metal is also disclosed in column 9, line 29-32. The thermal conductivity of silicon is approximately 120 W/mK and can be looked up in standard handbooks, so claim 19 is met by Herrell. Metals, generally, have even higher thermal conductivities than silicon.

Claims 1, 8, 10, 12, 13, 14, 16, 17, 19, 29, 30, 31, 32, 38 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Herrell in view of O'Neill et al (USP 4,896,719) and Tonkovich (USP 6,680,044).

Herrell shows a body 10 having a planar conducting portion 40. Plural heat sources 36 are shown. An intermediate conducting layer 44 is shown. The body has an inlet port 14 and an outlet port 16. Fluid from the inlet port is channeled to the conducting portion 40. The microchannels 42 in the conducting portion 40 distribute the fluid (after exchanging heat with the heat sources 36) after it has passed "therethrough" (i.e. through the microchannels 42 in the conducting portion 40) to the intermediate

conducting layer 44. The intermediate conducting layer 44 has fluid passing through it in through-passages (best seen running vertically between manifolds 48 and 50 in Figure 6 of Herrell) that fluidly connect the microchannels 42 in the conducting portion 40 to passages in the top layer 46 for eventual discharge from outlet 16.

To have replaced the microchannel layer (40) of Herrell with the corresponding porous layer construction of O'Neill (i.e. skin 15 and adjoining expanded foam 25) would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients as would occur when their were discrete heat transfer zones as is the case in Herrell. Note that porous microstructures have better heat transfer characteristics than microchannels as evidenced by Jiang et al article "Thermal-Hydraulic performance of small scale micro-channel and porous-media heat exchangers." Here the Jaing article is only relied upon to show an inherent property of porous microstructures compared to microchannels.

As disclosed the porosity of the expanded foam should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being claimed are ultimately for the designer to select in any given heat transfer application. To have configured the porous intermediate layer of Herrell/O'Neill with a porosity that is known to provide good fluid flow as taught by Tonkovich in col. 2, lines 50-63,

incorporated here by reference, would have been obvious to one of ordinary skill in the art to advantageously obtain extremely even cooling without any temperature gradients as would occur when their were discrete heat transfer zones as is the case in Herrell.

Claims 1 and 32 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over O'Neill (USP 4,896,719).

O'Neill shows a porous intermediate conducting layer 25 sandwiched between a conducting portion (layer 15) and another porous layer 12. An inlet 16 and outlets 24 are shown. As disclosed the porosity of the expanded foam should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being claimed are ultimately for the designer to select in any given heat transfer application. Regarding claim 32, every foam material by the nature of its formation is formed with irregular pores that inherently vary randomly over the flow path as a consequence of their random orientation.

Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over O'Neill et al (USP 4,896,719) as applied to claim 1 and 32 above, and further in view of Tonkovich (USP 6,680,044).

To have sized the pores of O'Neill (i.e. expanded foam 25) as taught by Tonkovich would have been obvious to one of ordinary skill in the art to advantageously obtain reasonable fluid flow. As disclosed the porosity of the expanded foam should be such that heat exchange medium flows freely. With respect to claims 29-30 applicant has shown no criticality whatsoever and the art recognized tradeoff between getting adequate heat transfer and avoiding excessive pressure drop suggests that the variables being claimed are ultimately for the designer to select in any given heat transfer application. To have configured the porous intermediate layer of O'Neill with a porosity that is known to provide good fluid flow as taught by Tonkovich in col. 2, lines 50-63, incorporated here by reference, would have been obvious to one of ordinary skill in the art to advantageously obtain good fluid flow without unreasonable pressure drops.

Claims 41 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of the prior art references as applied to claim 1 above, and further in view of Cardella (USP 5,918,469) or WO 01/25711 A1 (cited by applicant).

Cardella teaches a thermoelectric cooler 24 between a heat source (an integrated circuit chip 22) and a liquid-coolant type heat exchanger 20. To inserted a thermoelectric cooler between each of the integrated circuits 36 of Herrell and the bottom layer 40 of Herrell to advantageously cool the integrated circuits even more would have been obvious to one of ordinary skill in the art in view of Cardella. Alternatively, to have replaced heat exchanger 20 of Cardella with the microchannel

heat sink assembly 12 of Herrell to advantageously improve cooling in Cardella would have been obvious to one of ordinary skill in the art.

Finally, to have replaced either or both of the heat sink assemblies of WO 01/25711 A1 (cited by applicant) best seen in Figure 2 (18 and 19 at the bottom and 15 and 16 at the top) with the heat sink assembly 12 of Herrell would have been obvious to one of ordinary skill in the art to improve the cooling performance by advantageously reducing the length of the fluid flow paths.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John K. Ford whose telephone number is 571-272-4911. The examiner can normally be reached on Mon.-Fri. 9-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cheryl Tyler can be reached on 571-272-4834. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

John K. Ford
Primary Examiner